

RAPTOR RESEARCH NEWS

Volume 4

*Numbers one through six
January - December, 1970*



RAPTOR RESEARCH FOUNDATION, INC.

RAPTOR RESEARCH NEWS

Volume 4

Number 2

March–April 1970

Editors: Byron E. Harrell; Donald V. Hunter, Jr.



The *Raptor Research News* is designed as an informal information exchange. Contributions are edited, but are not usually submitted for refereeing as in formal scientific journals of record. Some of the items are progress reports or expressions of ideas to stimulate discussion; thus citations of contents of the *News* should be avoided unless approval is received from the author.

NOTES, NEWS, AND QUERIES	34
Notes on Raptor Research Foundation	34
Back Issues of the News	34
New Reports on Pesticides in Eagles	34
More DDT Effects	35
Ospreys in Scotland	35
Sea Eagles at Fair Isle	35
London's Wildlife	36
Saving Birds of Prey	36
Eagle Owls in Germany	36
Delaware Protects Raptors	36
Secretary Hickel Halts Issuance of "Blanket"	
Permits to Kill Golden Eagles	36
Nelson Broadens Pesticide Attack	37
Use of Falconry at Airbase in Spain	39
Falcons Protect Aircraft	39
More Missing Members	39
Continental Osprey Status Survey –1969	40
BREEDING PROJECT INFORMATION EXCHANGE	41
RAPTOR RESEARCH SURVEY	47
PEREGRINE FALCON POPULATION DYNAMICS DEDUCED	
FROM BAND RECOVERY DATA (Williston Shor)	49
THE EUROPEAN SPARROW-HAWK—BREEDING IN	
CAPTIVITY (Hans Herren)	60

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NOTES, NEWS, AND QUERIES

Notes on Raptor Research Foundation. We are gradually getting chairmen for the various committees. The following have been or recently agreed to serve as chairmen:

Editorial Committee: B. E. Harrell, University of South Dakota

Captivity Breeding Committee: Don Hunter, Centerville, S. D. (pro tem).

Raptor Population Committee: Tom Cade and Clayton White, Cornell University (Co-Chairmen)

Raptor Banding Committee: Fran Hamerstrom, Plainfield, Wisc.

Raptor Pathology Committee: William Halliwell, University of Missouri

Pesticide Committee: Steve Herman, University of California, Davis

Raptor Taxonomy Committee: Clayton White, Cornell University

Bibliography Committee: B. E. Harrell, University of South Dakota

Membership Committee: George Jonkel, Huron, South Dakota

Since December Lee Eberly has been serving as Executive Secretary. He has made considerable progress in the office backlog. We appreciate his services which are worth much more than the token pay that we provide.

We are working on the report of the Cornell meeting and the index to the last three volumes of the *News* which have unfortunately been delayed. They will be in the mail to all members before the next issue is out.

Back Issues of the News. The first three years of the *News* appeared quarterly. We have a supply of all issues which are available at \$0.50 each or \$2.00 a volume.

New Reports on Pesticides in Eagles. Work done at Patuxent Wildlife Research Center on 45 Bald Eagles and 31 Golden Eagles found sick or dead in 18 states and Canada in 1964 and 1965 has been reported recently (W. L. Reichel *et al.*, Pesticide Residues in Eagles, *Pesticide Monitoring Journal* 3(3):142-144, Dec. 1969). Levels were considerably lower in the Golden Eagles. Some unknowns have been identified as PCB.

J. D. Lockie, D. A. Ratcliffe, and R. Balharry report on work in

Scotland (Breeding Success and Organo-Chlorine Residues in Golden Eagles in West Scotland, *J. Appl. Ecol.* 6(3):381-389, Dec. 1969). They compared the period 1963-65 before the banning of dieldrin as a sheep dip in January 1966 with the period 1966-68. The percentage of eyries successfully rearing young rose from 31 to 69% while the dieldrin in eggs dropped from 0.86 to 0.34 ppm. No other factors seemed to account for this relationship and the authors felt that there was confirmation of their hypothesis, "that contamination by dieldrin ingested with mutton carrion was the cause of a substantial decline in the breeding success of eagles in West Scotland."

More DDT Effects. Experiments at the Montana Cooperative Wildlife Research Unit suggest that two of the effects of sublethal doses of DDT are to make it more difficult for young predators to learn how to obtain their food, and to make it more difficult for prey species to avoid being killed by predators. (*Outdoor News Bulletin*, June). (*Kingfisher* 5(1):4-5, Sept.-Oct., 1969)

Ospreys in Scotland. Five pairs of ospreys either nested or attempted to nest in Scotland in 1968. The Loch Garten pair, visited by 37,500 people, reared two young. The second Speyside pair failed to rear any young for the sixth year running, breaking one egg and failing to hatch the other, which was fertile. At the third Scottish site, first used in 1967, three young were reared, one of which was recovered in Spain in December. A fourth pair built a nest nearby but did not lay, and elsewhere in Scotland a fifth eyrie was also found but without eggs. (*Scottish Birds*, Summer).

In 1969 four pairs of ospreys are known to have bred, and at least 20 other ospreys were reported in various parts of Scotland. Three pairs produced two young each, but the eggs of the fourth pair failed to hatch. The snowy owls bred for the third year running on Fetlar, Shetland. Including young from former years, at least 15 snowy owls are now present in Shetland, and it is hoped that some more may breed in 1970. (*Kingfisher* 5(1):5-6, 1969).

Sea Eagles at Fair Isle. The three young white-tailed or sea eagles from Norway, which were released last year on Fair Isle, Shetland, where they have long been extinct, came successfully through the winter, and are now regularly seen. They have learned to fend for

themselves, and food is no longer left out for them. (*Birds*, July). (*Kingfisher* 5(1):6, 1969).

London's Wildlife. A pair of kestrels has successfully reared a brood of four in a window box on the 16th floor of a block of flats near the Old Kent Road. (*Kingfisher* 5(1):6, 1969).

Saving Birds of Prey. A new method of saving rare and decreasing birds of prey, which usually lay two eggs but rear only one young, has been pioneered with lesser spotted eagles *Aquila pomarina* in eastern Slovakia. The newly hatched second young birds were removed from two eyries, and reared in black kites' nests, from which the young kites were removed to a third kites' nest. One young eagle was returned to its original eyrie just before it could fly, and left the nest along with its elder, but the other developed too fast and flew before it could be returned "home." It is suggested that this method could be used with other large birds of prey, such as the golden eagle and the lammergeyer. (*Berliner Naturschutzblatter*, December). (*Kingfisher* 5(1):7, 1969).

Eagle Owls in Germany. Determined efforts are being made by the Deutscher Naturschutzring to re-establish the eagle owl as a breeding bird in parts of northern and western Germany where it is rapidly decreasing or has become extinct. Releases of wild caught birds were found to be ineffective, because the old birds were killed by road or rail traffic while defending carrion prey and the young ones wandered away. Renewed attempts are now being made with young aviary-bred stock, with the assistance of the Ornamental Pheasant Trust. (*Kingfisher* 5(1):7, 1969)

Delaware Protects Raptors. Delaware's new bird protection law protects all non-game birds, including all birds of prey, excepting only crows, starlings and house sparrows. (*Audubon Conservation Guide*, July). (*Kingfisher* 5(1):10, 1969).

Secretary Hickel Halts Issuance of "Blanket" Permits to Kill

Golden Eagles. Secretary of the Interior Walter J. Hickel announced today that he has ordered a halt to a long-standing practice of issuing “blanket” permits authorizing the killing of golden eagles in one or more counties in a state.

In past years such permits have been issued when requested by a state, based on potential danger to the livestock industry in entire areas.

Intensive recent studies, Secretary Hickel said, indicate that golden eagles’ attacks on lambs and goat kids “are not widespread and that they do not threaten either the local economies or the livestock industry generally.

“To undertake unrestricted golden eagle control under these circumstances would inordinately diminish the golden eagle population which the Secretary is charged with the duty of protecting.

“I conclude, therefore, that the responsibility for protecting golden eagles outweighs the need for controlling eagles in order to alleviate local depredations, except in the most critical circumstances.”

Under a law enacted in 1940, the Interior Secretary is directed to protect the golden eagle. The law also requires that he investigate individual claims that eagles preying on livestock are causing economic hardship, and issue a permit for individual killing if investigation substantiates the claim.

Secretary Hickel noted that individual farmers and ranchers still may obtain a permit to kill golden eagles. Such permits, he directed, will be issued only after careful investigation, and with the personal approval of the Secretary.

Secretary Hickel also directed the Bureau of Sport Fisheries and Wildlife “to increase your efforts to find ways and means of repelling or discouraging attacks by golden eagles and to encourage the Wool Growers and other groups to adopt these and other methods that will minimize the potential for eagle depredations.”

Found mainly in the Southwest and Mountain States, golden eagles have been declining in numbers for many years. They are somewhat smaller than the bald eagle, America’s national bird, and sometimes are confused with the young of the bald eagle. (News release from Department of the Interior, March 6, 1970)

Nelson Broadens Pesticide Attack. Faced with the painful reality that nothing short of a legislative demand will force the Department of Agriculture and the pesticide industry into dumping the persistent pesticides in favor of safer chemical and nonchemical controls, Wisconsin Senator Gaylord Nelson introduced a package of eight bills

to prohibit the interstate sale and shipment of eight insecticides in the chlorinated hydrocarbon insecticide family—aldrin, chlordane, DDD/TDE, dieldrin, endrin, heptachlor, lindane and toxaphene. These proposals are similar to a bill he sponsored last year to ban DDT.

“The long-term toxicity of chlorinated hydrocarbon pesticides presents a deadly threat to fish, wildlife and the overall quality of the environment,” Nelson said. “Evidence of environmental damage caused by hard pesticides has been found in nearly every part of the globe. Yet no significant action has been taken to stop pesticide pollution.”

“The Agriculture Department’s plan to cancel certain uses of DDT never even got off the ground before the pesticide industry initiated a complex series of appeals that could delay final action for years,” he charged.

Under the Agriculture Department’s regulations, manufacturers who appeal a cancellation order can continue to produce and sell pesticides until the appeal is resolved.

“It looks like the Department played right into the industry’s hands by failing to use its statutory authority to suspend certain uses of DDT before starting the cancellation proceedings,” Nelson added. “If the Department is serious about protecting the quality of our environment from pesticide poisoning, it should move without further delay and immediately suspend all nonessential uses of DDT.”

Nelson said that the pesticide industry’s “continued resistance to reform coupled with the Agriculture Department’s historical hesitancy to act makes it mandatory that legislative deadlines be set for banning persistent pesticides.”

Seven years ago, a Presidential Science Advisory Committee concluded that the goal of all national efforts should be the “elimination of the use of persistent toxic insecticides.”

This recommendation was confirmed by the recent Department of Health, Education and Welfare Commission report which urged restrictions on persistent pesticides hazardous to human health or environmental quality.

Nelson said that neither the Agriculture Department nor industry appears willing to mount an all-out effort to improve alternative means of pest control. “The Agriculture Department has admitted that its programs to develop better nonchemical means of pest control were underfunded by at least \$4 million last year,” he said.

There is no indication in the Department’s budget for the coming year that any substantial increase in funds will be available for expanded research in the fields of biological pest control, hormonal techniques, natural plant resistance and cultural control, Nelson said. (*Conservation News* 35(5):8-9, March 1, 1970).

Use of Falconry at Airbase in Spain. A recent article in the *Guardian Weekly* (102(4):7, Jan. 24, 1970) by W. Cemlyn-Jones tells about Operation Bahari initiated at Torrejon, a U. S. airbase near Madrid, Spain, after nine "bird-strike instances" in 10 months. One repair job ran to \$74,000. The falconry program was initiated by Spanish naturalist Dr. Felix Rodriguez de la Fuente and is now carried on by another falconer and a veterinary technician. The ten hawks, later increased to 14, were mostly taken from nests. In over a year and a half there have been no serious collisions, and daily sightings of birds on the 2½ mile runway have decreased from an average of 100 per day to less than two. The birds were flown especially at Little Bustards and Lapwings which formerly caused the most damage. Similar programs exist at two Royal Naval airbases in Scotland and at a commercial airport in Holland.

Falcons Protect Aircraft. The Royal Naval Air Station at Lossiemouth, Morayshire, Scotland has solved its bird-strike problem by importing peregrine falcons from the Middle East. Collisions between jet planes and black-headed gulls had been occurring about monthly, with \$100 thousand repair bills on the average. Various attempts to scare away or kill the birds met with little success.

In May, 1965, peregrines were introduced and were an immediate success. There have been no bird-strikes since then and the taxpayers have been saved over a million dollars a year. The birds have been trained to scare, rather than to kill as in traditional falconry, and as yet there seems to be no indication that the gulls are adapting by becoming accustomed to the falcons. (from *The Wildlife Society News* No. 126, p. 9, Feb. 1970).

More Missing Members. In our recent mailing we received a number of copies back without any forwarding information. It would help our office if our members would remember to tell us of their new addresses. We especially wish to remind students at this time of year. We have no addresses for the following:

John J. Burns

R. E. England

Patrick W. Grace

Verland T. Ogden

Thomas N. Smylie

Dale Spain

John F. Turner

Continental Osprey Status Survey – 1969. Under the auspices of the RRF Raptor Population Committee a survey of work on Osprey in North America was undertaken by Thomas Dunstan. A 31 page summary was prepared in January 1970 and sent to the 30 cooperators. Considerable information on past and present status in most areas of concentration in the United States and in a number of areas in Canada is contained in the summary. Because of its more general interest we are planning to edit this report and put it in the next issue of *Raptor Research News*.

BREEDING PROJECT INFORMATION EXCHANGE

The B.P.I.E. was initiated as a substitute for an earlier round-robin circulated among a number of persons with breeding projects. The first eleven numbers of the Exchange were sent to a limited mailing list. As announced in the last issue of the *News* the special mailings are discontinued; however, we are continuing the numbering of reports that are appropriate to this area that are printed in the *News*. For the convenience of our readers a list of the reports in previous B.P.I.E. issues are listed below. Additional copies of these are being prepared; past requests for copies are being filled shortly. New requests will be honored until July 1, after which we will not attempt to keep a supply available. We hope that anyone requesting these who has not previously given more than the minimum RRF contribution will help to defray the costs.

BPiE 1:2-4, Donald V. Hunter--various species; Oct. 1967

BPiE 1:5-13, Richard R. Olendorff--American Kestrel; Oct. 1967.

BPiE 2:2-3, Ryan B. Walden--various species; Nov. 1967

BPiE 3:2, James Enderson--Peregrine, Prairie Falcon; Jan. 1968

BPiE 3:3-4, Jimmie White--Harris Hawk, American Kestrel; Jan. 1968

BPiE 3:6, Fran Hamerstrom--Golden Eagle; Jan. 1968

BPiE 4:2-3, Richard Fyfe--Peregrine Falcon; Feb. 23, 1968

BPiE 4:4-13, Henry Kendall--Prairie Falcon; Feb. 23, 1968

BPiE 5:1-4, Fran Hamerstrom--Golden Eagle; Mar. 26, 1968

BPiE 6:1-5, Joe Simonyi--Peregrine, Red-tailed Hawk; July 26, 1968

BPiE 7:1, Donald V. Hunter, Jr.--registry; July 26, 1968

BPiE 8:1-2, Richard D. Porter, Stanley N. Wiemeyer--American Sparrow Hawk; July 26, 1968

BPiE 9:1-2, Jimmie White--Harris Hawk; June 3, 1969

BPiE 10:1, R. J. Hutchings--British Kestrel; June 3, 1969

BPiE 11:1, Donald V. Hunter, Jr.--information request; Goshawk; July 26, 1969

B.P.I.E. No. 12. Ronald Stevens (Fermoyle Lodge, Costelloe, Co. Galway, Ireland) on Peregrine Falcon breeding project (written August 27, 1969). There are no results from attempted captivity breeding this year. I attribute this to my falcon's being only in her third year and to the fact that she is a passager.

I have pleasure in supplying the information your circular letter calls for, as follows:

1. Diet. Two or three month old chickens with occasional pigeon.

Hawks are fed as much as they can eat daily but are made to pick every bone clean.

2. Breeding quarters consist of a wooden shed 40 feet long by 18 feet wide and 16 feet high from floor to eaves. It has six barred windows, three on the east side and one on each end, each 6½ feet high by 4 feet wide. The sixth window is on the west side and is of the same height but 6 feet wide. The sills of the lowest windows are 6 feet from floor level. The floor is of concrete overlayed with sand. This shed is now divided equally to accommodate 2 pairs. There is a bath 3 feet square cut into the concrete in each division. One tap with connecting pipe serves each bath. The perching ledges at each window have a cement surface. Cement also frames the nesting ledges. There are two nesting ledges in each division which are placed nearly at the height of the eaves. The nesting ledges consists of shallow wooden trays three feet square. They are fitted annually with clean turves of peat about 2½ inches thick which are fitted in one piece over turf mould 1 inch deep.

3. In one division is the intermewed passage falcon, described above. I received her from India as a red falcon in 1967. Her chosen mate is from two tiercels. He is an intermewed eyass, hatched 1965, of the type *F. p. peregrinus*. So, in appearance, is the falcon. In the other division is an American Tundra passage tiercel trapped 1968. His red falcon, imported from India, escaped early this year. The sliding door over one of the nest ledges, which gives access from the outside for the taking of eggs or young, shrunk and fell out leaving an aperture through which she escaped.

4. No artificial light.

5. The shed is completely isolated. No disturbance.

6. The two tiercels have been trained and flown. The falcon was well manned before being put into the shed. All three hawks are tame and steady. None is imprinted.

B.P.I.E. No. 13. Jimmie White (5741 Myra, Cypress, Calif. 90630) third report on Harris Hawk (see BPiE 3, 9) (February 16, 1970). Feb. 16, 1969: The birds have carried green grass and other greenery to nest, mostly oxcallis. Feb. 20: Having fed chicken necks almost exclusively all winter except casting once a week or every 7 days, it is time to change to live food. I feed day old chicks two days, nothing the third day or one day chicks and one day young rats, always nothing the third day. Feb. 24: Male observed carrying sticks to nest 8:00 AM. Feb. 27: Both birds carrying sticks.

Mar. 1: Birds observed breeding 1 time 9:00 AM. Mar. 24: The breeding pair are extremely nervous and very active all of the time, constantly flying from perch to nest, walking across the nest, then from perch to perch again. Sometimes the male will crouch in the

nest and call the female. She will come over to the edge of the nest and look in but I haven't seen her in the nest except carrying and arranging sticks and grass. Birds are not mating as often as last year or as many times per mating. Mar. 25: Birds observed mating 10:45 AM; single mating only. Wind blowing. Birds extremely nervous.

Apr. 2: Birds observed mating 6:30 PM; single mating only. Apr. 3: Birds observed mating 8:30 AM, single mating. Haven't observed more than single mating this year. Last year birds mated silent, this year they both always call very low. Apr. 4: Female observed setting on nest for about 30 minutes. Both still working on nest. Apr. 5: Birds observed mating 11:00 AM, single mating. Male jumped from edge of nest where mating took place into nest itself and set about 5 minutes. Apr. 7: Female was observed setting on nest from 6:00 AM to 10:00 AM. The male constantly bringing sticks and helping her arrange them. At 10:10 AM the female left the nest and crouched on the edge of the nest where the male mounted her. They mated for about 1 minute calling softly all the time. They are still only mating 1 time. Apr. 8: Birds observed mating 6:00 AM and again at 10:00 AM both single matings. No eggs yet. Female carrying greens (grass and other green plants) and placing them in the bowl or sides of the nest. The male has never been observed carrying greens to the nest, dry sticks only. Apr. 10: Birds observed mating 6:00 - 6:45, 7:30 all single matings. The only preliminaries seem to be flying around the cage very fast and almost constantly with little or no pause between flights, from perch to perch with low calling about every 2 to 3 seconds. It seems the same kind of call they use when mating except only about 1/3 as loud. Birds observed mating 4 times from 5:00 PM until 6:30 PM, all single matings. No contact was made on at least 2 of the first matings. Apr. 13: Bird laid first egg about 12:00 AM. She did not sit on the egg. Apr. 15: Second egg laid between 5:30 AM and 10:00 AM. After mating singly the female sat on the nest from 5:30 to 10:00, then she left the nest. Apr. 17: Bird laid 3rd egg about noon. The female began to sit steadily after the 2nd egg. Sometimes the male goes up and sits on the inside slope of the nest. The books say the male incubates the eggs too. He didn't last year, but maybe their instinct is getting clearer with practice or maybe it is age.

May 1: Birds are still carrying greens to nest, mostly oxcalia. There are only 3 or 4 types of plants growing in the aviary this time of year so there's not much choice. May 3: Female still sitting on nest. She is sitting alone the same as last year. But age, parenthood, or experience seems to be working on the male. For he will sometimes sit on the eggs for 5 to 10 minutes when the female leaves. May 16: Have been checking eggs every day at 5:00 PM. Today at 5:00 PM one eyass was half out of the egg, another had a hole about as big as a dime pecked through the egg. The other egg

seems to be rotten as it sloshes when shook. If tomorrow is warm I will try to take some pictures of the young. May 17: Took some pictures of the young birds. They can hardly hold their heads up. The parent birds did not feed the babies until late the second day. May 18: I took more pictures today. Young seem much stronger today and they can hold their heads up for a short time. The parent bird shows no aggression to me even when I hold the young in my hand. May 19: The female seems to be the only one feeding the young again this year. The male only brings the food to the nest. May 20: Male seems to be more aggressive this year and more protective of his territory. Today he somehow got a talon through the crack in the split bamboo wall separating the 2 cages and caught and held one of the cyass of last year by the wing and wouldn't let go until my wife heard strange noises and went out and called and made the male let go. May 25: Today I was in the bedroom when my shepherd began to bark; and as she is quite intelligent and almost never barks, I went out to the back yard. The male Harris had somehow gotten his foot through the wall and had a mature female Harris by the breast. After calling to him 3 or 4 times he let go. I immediately went in and made the wall solid. May 30: The young birds are 2 weeks old today. The feathers are beginning to show through the down and they are about 1 inch long now. The parents are still carrying greenery to the nest. They show a definite preference for baby chicks over rabbit, beef heart, or rats either grown or babies. I have also tried chicken necks, quail, both grown and babies, and they still seem to prefer baby chicks with either kind of quail next.

I will end my report now as I see no point in repeating myself. All of my observations in last year's report (BPIE 9) seem essentially the same as this year. I will give the weights of all 4 cyass for a later date. Feb. 10, 1970: The first cyass are now almost 2 years old and they weigh--Male-1 pound 10 ounces; Female-2 pounds 5 ounces. Second cyass are now almost one year old and weigh--Male-1 pound 8 ounces; Female-1 pound 9 ounces. I will end my report for 1969 with four cyass successfully raised in 2 years and a chance of more next year.

B.P.I.E. No. 14. Jimmie White, second experiment, first report on Harris Hawk (Feb. 16, 1970). May 23, 1969: I acquired a 3 year old female Harris. She was extremely tame and completely docile. She is larger and stockier than my original mature female. I will number these birds to make writing easier. I will call the original mature female number 1 and the new one number 2. May 24: No. 2 bird comes to food immediately, the others are sort of indifferent in spite of going hungry every 3 days. No. 2 doesn't seem to be aggressive,

she just sort of stays off on a corner perch by herself. May 25: No. 2 seems to be trying to establish a territory. She is beginning to call back to the pair in the next cage and I found the male with his foot through the wall holding No. 2 by the breast. I made him turn loose and she didn't seem hurt by the experience. May 27: No. 2 seems to be trying to establish a territory around the nest I built, and she seems to be making overtures to the young male from last years breeding. I have 4 birds together in the same cage so that they will have a more natural selection, but I am having trouble getting males. I have 2 mature females, one three years and one two years, and what I believe to be a male and a female from last years breeding. All of these birds are in the same cage together, first to try and give them a wider and more natural selection and second I am hoping to keep them from trying to establish a territory these by being less aggressive especially toward a male if and when I get one or more. May 28: No. 2 seems to be getting more aggressive. She has clearly become boss of the cage. I am going to watch her carefully and if she crabs or fights with any of the other birds I will separate her. She is already crouching on the nest and calling at me when I come to the door of the cage. May 29: Bird No. 2 is sitting on the nest for short periods of time. She will sit in the nest cavity and sort of roll around then reach out and move the nest material with her beak. She sort of piles the sticks and grasses around her. I found $\frac{1}{2}$ a flash light battery in the nest today. May 31: I put a plastic egg in the nest No. 2 has been using. The egg is joined at the middle, it presses together. After 4 hours I checked and one of the birds had separated the halves of the egg and moved the halves about 4 feet apart and 4 feet from the nest.

June 5: I was loaned a male Harris. At least I assume by the size it is a male. I will call this male No. 2; he weighs 1 lb. 13 oz. and female No. 2 weighs 2 lbs. 5 oz. June 7: Birds observed sitting together. No crabbing or fighting has been observed. June 9: Male No. 2 and Female No. 2 were separated from the other birds. June 16: Female went into a freak molt and seems to have lost the ability to fly. If I go into the cage to catch her, she runs around the ground and will not fly. I think this is a combination of molt and being overly fat.

July 1: By now birds have taken nest apart down to the platform. There is not even a twig left. Some of the sticks have been carried as much as 10 to 12 feet away from the nesting platform. July 20: Female is now partly jumping and partly flying up on to the low perches. July 23: Female seems to be getting better and better at flying, I guess she will be OK later.

Aug 1: Female seems to be fully recovered but too late for the nesting season this year. Aug. 10: Put pair No. 2 back in flight cage with 4 eyass to spend the remainder of the summer and part of the winter.

Dec. 25: Placed pair No. 2 in nesting cage together. No fighting or great excitement observed. Dec. 26: Birds observed sitting together and roosting together. Dec. 27: Birds observed sitting and roosting together. Dec. 28: Birds observed sitting and roosting together. I will stop this report now and begin on the 1970 one shortly.

RAPTOR RESEARCH SURVEY: 1970 No. 2

This is a continuation of the listing in the last issue of the *News* (4(1):8-13). A sixth category has been suggested for recently published work. We hope to send forms to new members who did not receive them earlier. Symbols: a—planning; b—in progress; c—nearly finished; d—manuscript; e—in press; f—recently published.

J. C. Adamson (Sierra College, 5000 Rocklin Rd., Rocklin, Calif. 95677): Requirements for the Sustained Captive Breeding of Avian Carnivores, in Particular *Falco columbarius* (a, b).

William C. Anderson (Otero Junior College, La Junta, Colo. 81050): Breeding Success of Great Horned Owls and Diurnal Raptors of Southeastern Colorado (a, b)

Craig A. Campbell (188 Lester St., Apt. 7B, Waterloo, Ontario, Can.): Decline of Waterloo Co., Ontario, Breeding Populations (especially Red-shouldered Hawk) (b).

John Eric Cooper (Veterinary Research Laboratory, P. O. Kabete, Kenya): Diseases of Birds of Prey (b).

Richard Fyfe (10015, 103 Ave., Edmonton, Alta., Can.): 1) Populations and Pesticide Residues in Arctic Peregrines (b); 2) Factors Affecting Western Canadian Prairie Falcon Populations (b); 3) Populations and Pesticide Residues in Western Canadian Raptors (b).

William G. George (Zoology Dept. S.I.U., Carbondale, Ill. 62901): The Relative Size of the Greater Coverts in Accipiters (b).

David L. Graham DVM (Dept. of Vet. Pathology, Iowa State Univ., Ames, Iowa 50010): Avian Metabolic Bone Diseases (Nutritional Secondary Hyperparathyroidism in Raptors) (b).

Leo Heugly (Coop. Wildl. Res. Unit, Colo. State Univ., Fort Collins, Colo. 80521): Golden Eagle-Livestock Interaction in West Texas (c).

Nancy J. Kitzmiller (see Robert M. Stabler).

Amelie Koehler (Katharinestr. 20, 78 Freiburg Br., Germany): 1) Comparative Ethological Studies in Falcons (b); 2) Captivity Breeding (b).

Richard D. Porter (Patuxent Wildlife Research Center, Laurel, Md. 20810), 1) Pesticide Effects on Raptors and Peregrine Breeding (d, e); 2) Sparrow Hawk Propagation (*J. Wildl. Mgt.*, July) (e); 3) DDE—Sparrow Hawk Eggshell Thinning (c); 4) Sparrow Hawk Reproduction in Captivity (c).

David G. Roseneau (¾ mi. Goldstream Road, Fairbanks, Alaska 99701): Numbers and Productivity of Gyrfalcons on the Seward Peninsula, Alaska (tentative title) (b).

James L. Ruos (Stabean Drive, Fulton, Md. 20759): Correlation

Mich. 49684): Growth and Development of Nestling Harriers (*Circus cyaneus*) (d).

Rollin D. Sparrowe (BSF&W, Univ. of Missouri, Columbia, Mo. 65201): Prey-catching Behavior of Kestrels--Effects of Motivation, Energetics on Prey-capture Abilities (a).

Robert M. Stabler (Colorado College, Colorado Springs, Colo. 80903): Studies of Malaria in the American Kestrel (*Falco sparverius*) (with Nancy J. Kitzmiller) (b).

PEREGRINE FALCON POPULATION DYNAMICS DEDUCED FROM BAND RECOVERY DATA

by Williston Shor
6614 32nd Street, N.W.
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INTRODUCTION

North American Peregrine Falcons survived without difficulty until the late 1940's. *Falco peregrinus anatum* bred and wintered largely in the United States and the forested portions of mainland Canada. The Tundra Peregrine Falcon (*F. p. tundrius*) breeds in the arctic and winters as far south as Argentina. The Peale's Falcon (*F. p. pealei*) inhabits the islands off British Columbia and southern Alaska and the Aleutian Island chain. The race *anatum* has been greatly reduced in the United States and southern Canada, probably because of chlorinated hydrocarbon pesticides, and the other races may also be threatened.

In the forty years between 1924 and 1963, no more than about 1400 North American Peregrine Falcons were banded. Since the banding of Peregrines resident in the United States has nearly ceased, and few of the northern races are being banded, it is essential to obtain as much information as possible from the data already obtained. The following is an attempt to do so.

Most of this analysis of population dynamics is based on a list of Peregrines banded and recovered before 1964. This list was summarized by Enderson in 1966¹ and is divided almost equally between northern migrants and southern residents. More recently the lists of Peregrines banded as reported by most of the banders who obtained recoveries have been made available. In addition, computer listings of birds banded in the years 1955 through 1966 have been prepared. Although both lists of birds banded are incomplete, they aid considerably the understanding of the recovery data.

SURVIVAL RATE OF BREEDING AGE PEREGRINES

Seventy-four recoveries in the list are of resident Peregrines from the United States or southern Canada; 73 are of presumably arctic migrant Peregrines; and one is of a Peale's Falcon. Sixty-seven of the 74 resident falcons were banded as nestlings. Four were banded as adults, and there is no data on age when banded for the remaining three. Most of the 73 arctic migrant Peregrines recovered, on the other hand, were banded in the United States while on the

southward migration in the fall. Fifty-two of the 73 were in immature plumage when banded, including three nestlings, and thirty-four of these were still immature when recovered. We wish to consider only birds of breeding age. Peregrines do not normally breed until the second spring after they are fledged. Therefore we must eliminate from our sample recoveries of birds banded while immature in the year after banding and the next year. We must also eliminate recoveries of birds banded as adults during the year after banding, not only to eliminate the birds banded as first-year adults but to eliminate possible bias from the relatively high recovery rate of some adults shortly after banding—three of the four *anatum* birds banded as adults were recovered within a month. Because this process reduces the size of the sample, it is desirable to add data from other populations. Data on Peregrines recovered in Great Britain is available², and as will be shown, it is very similar in pattern to that on North American adult Peregrines. It will therefore be used.

Eighteen recoveries are available for presumably arctic migrant Peregrines banded no later than the fall migration and recovered no sooner than the following fall, and there are twenty-two records of southern resident Peregrines recovered more than a year after banding. There are fifteen recoveries made in Great Britain more than a year after banding. Three of these birds were banded in Norway and Sweden, the remainder in Great Britain. The distribution of these fifty-five recoveries is shown sorted by population in Table 1 to illustrate how parallel the data are for all three groups. In this table, the second year starts one year after the date of banding for the southern residents and for those recovered in Great Britain, nearly all of which were banded as nestlings. For the arctic migrants the second year starts August 15 of the calendar year following banding.

Table 1. Peregrine Recoveries Sorted by Population

Year After Banding	2	3	4	5	6	7	8	9	10	11	12	13	14
Arctic Migrants	6	2	3	1	3	1	2	0	0	0	0	0	0
Southern Residents	6	4	2	3	3	1	1	0	0	0	0	1	1
Recovered in Great Britain	6	0	3	3	1	0	2	0	0	0	0	0	0
Totals	18	6	8	7	7	2	5	0	0	0	0	1	1

Because of their similarity in pattern, it seems reasonable to combine all three populations into a single larger group, and then redivide it into birds banded as nestlings or immatures, and birds banded as adults, as shown in Table 2.

Table 2. Peregrine Recoveries Sorted by Age When Banded

Year After Banding	2	3	4	5	6	7	8	9	10	11	12	13	14
Banded as Nestlings or Immatures	13	5	7	6	5	1	4	0	0	0	0	1	1
Banded as Adults	5	1	1	1	2	1	1	0	0	0	0	0	0

One can, in principle, begin life table computations at the end of the third year after banding just as well as at the second, assuming a model which is that of constant death rate for adults. Changes in band loss for the later years may make a slight difference in the results, but in this case this effect appears unimportant. When the third year after banding is accepted as the base year for the birds banded as nestlings or immatures, and the second year after banding used for the birds banded as adults, and the recoveries are combined, Table 3 results.

Table 3. Recoveries of Breeding Age Adults in Base Year and After

Year After Base Year	Base	1	2	3	4	5	6	7	8	9	10	11	12
Number Recovered	10	8	7	6	3	5	1	0	0	0	1	1	0

If we assume not only the death rate but the probability of recovery remains constant for an individual of breeding age as long as it is alive, then the theoretical curve for the number of recoveries as a function of years after banding is of the form

$$L_x = c_x L_0 e^{-rx}, \qquad \dots \text{Equation (1)}$$

where L_x is the expected value of the number of birds recovered in the x th year after the base year. The quantity c_x is a correction for the reduced numbers of banded birds available for recovery in a given age group because of the finite length of the observation interval and for band loss, with $c_0 = 1$. The quantity r is the probability of death

within a year for a bird of breeding age.

Table 4 for the quantity c_x has been developed using the available records of birds banded each year during the interval of observation in North America, and using the assumption that serious band loss does not start until the fourteenth year after banding ($x=11$). The British pattern of banding and the interval of observation are much like the North American. The assumption on band loss is based only on the observation that Peregrines walk very little, and on the condition of two recovered bands. An actual band worn about five and one-half years shows very little wear, and a microfilm of a band worn eight years was reported by the Bird Banding Laboratory at Laurel, Maryland to be clear and the numbers easily legible.

Table 4. Values of the Parameter c_x

x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c_x	1	.96	.94	.89	.84	.79	.73	.68	.65	.60	.57	.45	.35	.23	.10	0

Using the recovery data of Table 3 and the values of c_x from Table 4, a maximum likelihood calculation produces the values $r = 0.25$ and $L_0 = 10.9$ for the parameters of equation (1). The reciprocal of r is the life expectancy of a breeding age Peregrine—four years.

The value of 0.25 for r is compatible with the observed rate of decline of the Peregrines in the upper Mississippi River area³ (r about 0.24 from 1955-62), and those migrating through Belgium⁴ (r about 0.21 from 1951-59) during their respective population crashes, where breeding failure appears to have caused the population to die off at close to the normal adult mortality rate. The decline in Finland⁵ was somewhat steeper (r about 0.4), perhaps because (as can be inferred from their greater band recovery rate) those Peregrines were under greater shooting pressure on their wintering ground than those in North America.

REQUIRED NESTING SUCCESS FOR A STABLE POPULATION

From the life expectancy of four years computed above for a bird of breeding age, and the fact that the Peregrine does not normally start breeding until it is two years old, it is a simple matter to determine the number of young birds which must be fledged and survive to breeding age if the population is to be maintained. Since it is probable that not all breeding age birds occupy nesting sites, several values for the per cent of breeding age birds nesting and for proportion of birds fledged surviving to breeding age are used to show the effect of these two variables on the required productivity of nesting pairs to maintain an equilibrium population (Table 5).

This table is correct only for a value of $r = 0.25$, that is an adult life expectancy of four years. The entry at the upper right-hand corner of the table, 0.68, corresponds to a survival rate for immature birds as high as for adults with all of the breeding age birds occupying nesting sites. Both are unlikely. Clearly, a productivity of less than 0.68 young per pair will result in decline. The actual productivity required must be higher.

Table 5. Average Number of Young Which Nesting Pairs Must Fledge as a Function of Per Cent of Breeding Age Birds Nesting and of Survival of Fledglings to Breeding Age

Per Cent of Breeding Age Birds Nesting	Proportion of Birds Fledged Surviving to Breeding Age				
	0.2	0.3	0.4	0.5	0.6
100	2.21	1.48	1.11	0.89	0.68
90	2.46	1.64	1.23	0.99	0.76
80	2.76	1.84	1.38	1.11	0.85
70	3.16	2.11	1.58	1.27	0.97

RECOVERY RATES OF BANDED PEREGRINES

A. Recovery Rates for Principal Sub-Populations. The recovery rates for banded birds can be determined from the banding data and the recovery data taken together if care is taken to eliminate bias which might result from the fact that only part of the banding data can be found. The original banding records in the files of the Bird Banding Laboratory have been located for most of the banders shown on the list of recoveries. They have not been located, however, for banders who banded Peregrines before about 1955 and obtained no recoveries. Banding records located by identifying all those banders who obtained recoveries have a very high probability of including all banders who banded many Peregrines, but they may not include a significant fraction of those who banded few. It follows that a recovery rate calculated as the ratio of the total number of recoveries reported to the total number of birds banded by those banders who obtained recoveries will certainly be an overestimate of the true band recovery rate.

One method which has a high probability of eliminating bias from this cause is to limit the sample to the birds banded by those few banders who obtained a relatively large number of recoveries. These banders must have banded enough birds so that there is only small probability that other banders who banded as many birds obtained

no recoveries and so were not included on the list. Table 6 includes only birds listed in the banding data for banders who obtained five or more recoveries (or in the case of banders in Wisconsin, four or more recoveries). There is about 90 per cent probability that the entries in that table are not biased by the effect discussed above.

Table 6. Recovery Rate by Sub-Population

Sub-Population	Per Cent Recovered	Standard Deviation (Per Cent)
Resident Peregrines from the U.S. and Southern Canada	12.1	2.0
Arctic Migrants Banded on Southward Migration in Wisconsin	15.0	3.0
Arctic Migrants Trapped on Southward Migration on Atlantic Beaches	6.3	1.6
Arctic Migrants Banded at the Nest in Alaska	1.9	1.9
Arctic Migrants Trapped in Texas During the Fall	23.0	7.1

B. *The Recovery Rate of Immature Peregrines as an Indicator of Death Rate.* When compared with that for adults, the recovery rate of immature birds is well known to be high for many species. However, it does not necessarily follow that a high recovery rate implies a proportionately high death rate, and we must deduce from other indicators the relationship between the recovery rate and mortality rate of immature birds.

The population which nested in Massachusetts and was reported on by J. A. Hagar⁶ provides much pertinent data. During the years 1935-42 the population was stable. Eighty-eight nestlings were banded. Of these, 14 were recovered. Only four of these had attained breeding age when they were recovered, and one might infer from this that only four in fourteen of all birds fledged, or 29 per cent, survived to breeding age. That this is incorrect follows from the known productivity of the breeding birds. During this period of stable population the observed productivity was only 1.14 birds fledged per occupied nesting site. Interpolating in Table 5 we find that if 90 per cent of the breeding age birds actually occupied nesting sites, then about 45 per cent of the fledglings must have survived to breeding age. We should have obtained only four or five recoveries of

birds at less than breeding age, rather than the ten actually obtained, if the recovery rate had been proportional to the death rate of such birds. Furthermore, nine of the ten recoveries at less than breeding age were of birds less than one year old, and only three or four should have been if the recovery rate had been proportional to the death rate. Hence we find that the immature recovery rate probably exaggerates the immature death rate by at least a ratio of nine to four, or more than a factor of two.

A somewhat different approach has led to the same conclusion in the case of migrant Peregrines banded in Wisconsin and Texas, but not for those banded on the Atlantic beaches. In the case of the birds banded on the Atlantic beaches the shooting pressure is probably very low, and the recovery rate for immature birds roughly proportional to their death rate.

C. High Vulnerability of Immature Arctic Migrants Banded in Texas. The recovery rate of migrant Peregrines banded in Texas while in immature plumage is very high. Twenty-five immature birds and ten adults were banded in the fall migration by the one bander who obtained five or more recoveries. Seven of the immature birds banded were recovered by the next spring, and one in the following fall. All but one were recovered on or near the Gulf Coast, and all but one were shot. How many additional birds were shot and not reported is not known. However, investigations of the recovery rates for ducks and doves have disclosed that less than half of the bands recovered by hunters are reported under ordinary conditions^{7,8}. With hawks the proportion may well be less. It seems possible that more than half of the immature Peregrines which reach Texas are shot before the following summer, especially since many of these birds winter in Texas where they are readily shot, as shown by the band recoveries there in winter and spring.

D. Recovery Rate of Arctic Migrants Banded in Wisconsin. The recovery rate of immature arctic migrants banded in Wisconsin is also high, although not as high as that of birds banded in Texas. Of 141 migrant Peregrines banded in Wisconsin, 21, mostly immature birds, were recovered, largely to the south in the same fall they were banded.

E. Recovery Rate of migrant Peregrines Trapped on the Eastern Seaboard. Not only is the overall recovery rate very low for migrants trapped on the beaches of the Eastern Seaboard, as can be seen in Table 6, but the recovery rate for immature birds is markedly lower than elsewhere during their first year of life. Only four of 142 immature birds banded on the fall migration were recovered before the following August 15. The very low recovery rate may be a

consequence of low shooting pressure on the Atlantic Seaboard beaches. The records of recoveries show none of these birds which were released where they were trapped (*i.e.*, not transported inland) were recovered in the United States anywhere except the Atlantic Seaboard beaches and Key West.

AGE RATIOS OBSERVED AMONG MIGRATING PEREGRINES

The west shore of Lake Michigan and the barrier beaches of the Atlantic Coast are two of the most important places from which the fall migration of Peregrines can be observed. In both places, far more immature birds than adults were observed over the period from 1938 to 1967. Berger reported to Henderson⁹ that his observations in Wisconsin over many years added up, in those cases where age and sex was determined, to 114 immature birds and 17 adults—a ratio of over 13 immature birds to each two adults. Rice and Berry¹⁰ reported that 368 immature birds and 69 adults were caught at Assateague Island, Maryland during the years 1954-65—a ratio of 10.7 immature birds for each two adults. However, even at the time of the fall migration the adults must exceed the immature birds in numbers. If we assume that on the average 1.5 birds are fledged from each occupied nest, as reported by Hickey¹¹ for 67 British and American sites, there will be no more than about 1.17 fledglings produced for each two adults because about two adults in nine will be non-breeding first-year adults. When we allow for the fact that some breeding age birds also do not nest, and for losses from the time of fledging until the birds are seen on the migration, we cannot count on much more than about one immature bird for every two adults by the time the birds reach the United States. It follows that a large part (of the order of ninety per cent) of the adult birds are not seen in migration. If, also, as seems likely, only a fraction of the immature birds are seen, then only about a tenth that fraction of the adults are seen.

GEOGRAPHICAL SEPARATION OF ARCTIC MIGRANT PEREGRINES FROM SOUTHERN RESIDENTS

The banding returns show a distinct separation in locations of band recoveries along the Eastern Seaboard between the arctic migrants and the southern residents. None of the 74 banding returns from the Peregrines which nested in the United States and Southern Canada are from the Atlantic beaches. On the other hand, no Peregrine Falcon banded and released on Assateague Island, Maryland through 1963 was recovered inland in the United States, although they were found on the Atlantic beaches of the eastern United States, south through the Caribbean into South America and

north to the west coast of Greenland.

POPULATION ESTIMATES FROM THE BANDING DATA

The available lists of birds banded on the Atlantic beaches show that an average of about five adults and seven immature birds were banded annually during the period from 1939 through 1962. No recoveries of the birds on these lists were made by banders in subsequent migrations. It is possible to show from this that the probability is at least 0.95 that the population from which the birds migrating along these beaches was drawn consisted of at least 1000 adults, and that the probability is at least 0.5 that the population consisted of at least 4500 adults. The situation is analogous to that of drawing balls from an urn: if a ball is drawn from an urn containing only a few balls, marked and returned, then the chance of drawing it again if the contents of the urn are well mixed is high; if, on the other hand, the urn contains many balls, the chance of drawing the marked ball again is small.

Using the same productivity as was assumed in the discussion of age ratios observed among migrating Peregrines, a population consisting of 1000 adults can be expected to produce on the order of 400 or 500 immatures at the time of the fall migration.

SOME DEDUCTIONS FROM THE RESULTS

Certain conclusions may be drawn from the data presented in this paper which may be helpful in considering the interaction of man with the Peregrine Falcon population.

A. Effect of Trapping on the Migrant Peregrine Falcon Population. Ten per cent or less of the adults migrate on the Atlantic and Lake Michigan beaches with the immatures. Therefore shooting or trapping pressure on adults on these beaches is unlikely to have a large direct effect on the adult segment of the migrant population.

B. Protection of Southern Residents While Trapping Migrant Peregrines. Because of the behavioral separation of races, trapping of migrant Peregrines on the Atlantic beaches, on the Gulf Coast, and in Florida could be expected to have no effect on the population resident in the United States and southern Canada even if it were to recover.

C. Potential Indicator of Declining Tundra Peregrine Population. The most sensitive indicator of an impending decline would be the disappearance of the immature birds from the migration routes while the adults continued to be observed. If a ratio of the order of five or

more immature birds to each adult continues, this can probably be taken as evidence that the birds are continuing to breed, and that any decline will be slow. If the ratio falls off sharply and stays low, it will probably signal a population crash. In the fall of 1969, the ratio of immatures to adults remained high in over 200 birds sighted on the beaches of the Eastern Seaboard, but had fallen to half of its value five years previously in Texas¹².

D. Effect of Harvest of Immature Peregrines from the Population. It will be recalled that the population which migrates through Wisconsin withstood far more gunning pressure than was imposed on the population migrating along the Atlantic beaches and seems to have done so without measurable effect. In view of the apparent continuing lack of gunning pressure on the Atlantic beaches, the population which migrates down them can almost certainly withstand some trapping of immature birds without difficulty so long as it continues to breed successfully. The size of the harvest needs to be determined. However, based on the calculations of this paper, there appear to be at least the order of 500 immature birds produced each year. In fact, observations of about 200 Peregrine Falcons, mostly immature, on the Atlantic beaches in the fall of 1969 as reported by qualified observers to R. B. Berry¹³ and to the author indicate that the production must still be considerably greater than 500 birds, since it is not conceivable that as many as a third of the total immature population were sighted. Regulating the harvest of these birds on the basis of an assumed production of 500 immature birds per year should be a conservative approach.

ACKNOWLEDGEMENTS

The author is indebted to Mr. Earl B. Baysinger, Chief of the Bird Banding Laboratory, Laurel, Maryland for providing copies of the original lists of birds banded from the files of the Laboratory, and to Dr. J. H. Enderson for his continuing encouragement and valuable suggestions.

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THE EUROPEAN SPARROW-HAWK—BREEDING IN CAPTIVITY

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From various motives, increased attempts have been made recently to induce captive birds of prey to breed. A report is given below on the breeding in captivity of European Sparrow-hawks (*Accipiter nisus*).

Parent birds. After obtaining an injured adult male bird (two or more years old) in January 1968, I succeeded in healing it and manning it to a certain degree. Eventually I found that the bird was unable to use its left wing perfectly, and so it must still be kept in captivity. In March of the same year, on my request, the Swiss Ornithological Institute, Sempach, provided me with a female Sparrow-hawk, whose broken wing and leg had healed but who was almost incapable of flying.

In these two birds, both unable to live in freedom but who were otherwise healthy, I found the necessary conditions for a breeding attempt. At the present state of our knowledge and possibilities in the breeding of birds of prey, the reflection may be justified, not to commence with the sensitive and quick-reacting Sparrow-hawk but to experiment first with a more "favorable" species. But by chance, the two birds came into my hands so I had no choice and on the grounds of some 12 years' experience of Sparrow-hawks, it seemed to me that I should seize the opportunity and, above all, not let such a chance go by without having tried every means possible within my capabilities. Suitable Sparrow-hawks fly only seldom into my house and then only one by one. Even if an attempt to breed with two tame nestlings might have been more rewarding, it seemed that the choice of two adult birds who had possibly already bred in freedom, might give more promise of success. I could also imagine that young birds, in continual contact with their keeper, might find difficulties in becoming familiar with another of their own kind.

Aviary. Since the male could fly quite adequately if at times for short periods only, but the female could only manage a short flight of about 1 meter, I had to consider using elder for the perches when equipping the aviary (2.10 m long, 1.50 m broad and 1.90 m high). I was able to make a perch for the male which was out of reach of the female. The feeding board is inside the door at a height of 70 cm. The floor space is half-filled with spruce twigs. The front of the area

consists of upright laths, and wire-netting is nailed on the outside. The exceedingly shy female, who resisted all attempts to tame her, fluttered around wildly every time a human being appeared so that I was compelled to erect a screen of wire-covered frosted glass about 1 meter outside the laths. On the solid side-wall, on the other side of which is a window-less small space, firmly nailed forked branches are to constitute the basis for the future nest. Immediately above the branches, I fixed a so-called spy-glass in a 10 x 20 cm opening as an observation window. From daylight until dark, the glass served as a mirror, from the dark space it is transparent and ensures a view into the aviary without the knowledge of the inmates.

Marquart (1967) favors cages with plastic net sides, a wire-netting roof and a floor which is as thickly covered as possible. This arrangement ensures enough light, is sufficiently screened off externally, and the inside temperature is favorable. The existing space available for my Sparrow-hawks probably represents the minimum; the dimensions, however, are adequate for two birds whose flight is limited. The vertical laths at the front prevent head injuries when the birds attempt to fly—they are recognized as an obstacle and parried with the claws—in contrast to wire netting. The transparent, hard plastic roof, built subsequently, ensured light, but the solid boarded walls made the interior so dark that a lamp was necessary. I used elder perches on account of the rough bark and ready availability and took care that the branches varied in thickness. These were fixed at different angles to ensure a change of position and to avoid the same continuous strain being placed on the feet. Dry spruce needles cover the floor lightly; they absorb dirt and are less dusty than peat. The rear half of the floor is covered with green pine brushwood to a height of about 10 cm. Food remainders falling from the feeding place disappear amongst the twigs and are inaccessible for the birds.

Light. In the course of the summer of 1968, I found my views confirmed in the works of Marquart (1967) and later, Koehler (1968), inasmuch as the aviary indicated for Sparrow-hawks is too dark. I then replaced the wooden roof by corrugated clear plastic and 5 cm under this, I stretched transparent plastic sheet to protect the male, should he eventually fly against the roof. The aviary was thus much lighter. Later, I placed a 100-watt lamp in such a position in the corner between the screen wall, side wall and roof, that it illuminated the whole interior. From the middle of January until the end of March 1969, the lamp always burned from 6:45 until 7:45. In the evening, it was switched on at first at 17:00. (With increasing daylight and on clear days, correspondingly later.) In January, the light was switched off at 19:00, in February at 20:00 and in March, towards 21:00. Say once a week probably, there was no light on

account of my absence.

Getting accustomed to each other. At the beginning of April, 1968, when I put the two birds, now accustomed to each other to some extent, into the aviary, the year was too far advanced to count on their breeding. It was, therefore, essential to keep the pair in a healthy condition until breeding time, 1969.

At the beginning, the male, weighing 140 grams, fled from his heavier partner (260 grams). In the course of a few weeks they became accustomed to each other and today, after breeding, it is the female who is shyer rather than the reverse.

When I received the female, the male was so much at home with me, that I was able to hold him on a bow perch on jesses with elastic leash. At first, the female was put in a roomy packing case with vertical bamboo laths at the front. The case and the bow perch were so placed that the two birds could see each other. After a week, the female also had a bow perch but her behavior was not good as she was too shy. I had put the male into the aviary some days before the female so that as regards becoming familiar with his new quarters, he would have the advantage and be able to assert his mastery from the beginning. In the present case, it may have helped to contribute to success that the female was hindered as regards flying to a greater extent. With birds whose flight is not handicapped and in a species where there is a marked difference in size between the sexes, the advisability of "braking" the female should be considered. This is done by binding some of the flight feathers lightly with adhesive tape. In the confined space of an aviary, it is impossible for the male to keep the desired distance. In the stage of getting accustomed to each other and pairing, the continual feeling of threat could prejudice the desired course of events.

Food. Twice or three times daily, I fed newly-killed mice after skinning and removal of stomachs and intestines. According to outside temperature, time of year and age of the mice, daily requirements of the two birds together varied between 90 and 100 grams. At times, I fed them small birds, recently killed by accident. Water was rarely required—probably my Sparrow-hawks bathed and drank less than once per month.

For the bird-hunting Sparrow-hawk, mice constitute a substitute food. In feeding them freshly killed mice, then at the expense of regular food, a larger proportion of hair is consumed (although I had earlier kept Sparrow-hawks who plucked their mouse clean in 1-2 hours) and at times, the birds could have hardly had sufficient food. Reminders of mouse skin on the head and legs suffice for the formation of castings. I had, moreover, still a further reason to skin the mice: in the case of eventual success in breeding, the young birds

with their white down in the nest and the white, furry food would be similar in appearance—I did not want to run any risks! When consuming a mouse whole, the Sparrow-hawk usually rejects the stomach and intestines. It is less troublesome for me if I remove the intestines etc. immediately than if I have to collect these food remainders at night from the floor.

Behavior and maintenance. As soon as the birds established a sitting distance of 20 cm on the same branch and remained there overnight, I re-arranged the branches in such a way that from now on, they were all accessible for the female. As her fear of humans and noise was still on the increase, I showed myself to the birds as little as possible and laid their food on the feeding board through a small, push-opening in the door. Thereupon the male bird always took the mouse on the left side (as he saw it) and devoured it on the highest branch. It was only then that the female took her share and devoured her meal on the middle branch.

Preparation for breeding. In the second half of March 1969, the call of the male increased frequently, both before and after feeding and likewise, more frequently, the female uttered varying small cries as soon as she had taken her food. During the last days of March I was absent. On the 1st of April, I discovered that the female either did not fetch her food or, then only after a delay of 5-10 minutes. By day, the male did not fly up to his usual eating place with his mouse but, calling continually, consumed the head somewhat awkwardly on the ground with frequent interruptions and then offered food to the female who was standing on the middle branch. She approached with lowered head and tried to take the food with her beak, but at the last moment, the male took refuge on the floor. Then the female sprang after him and took the food he had relinquished when he took refuge on a higher branch. From now on, the female never fetched her food from the feeding board: everything had to be offered to her by the male.

Nest. During the night, I hastily built up foundations for the nest with green pine cones, radiating from a center and a few dry larch twigs. Additionally, I threw several handfuls of dry larch and pine twigs on to the floor. On the following morning, the 4th of April, about 20 small twigs were to be found all mixed up together on the foundation. In the evening, among them, I found a broken egg on the floor, which had apparently fallen through holes in the loosely built nest platform. The next night, I built a solid Sparrow-hawk nest from dry twigs, bound the ends firmly with florists' wire and threw two handfuls of pieces of spruce bark into the hollow.

In the course of propagation, the nest-building Sparrow-hawk

must play his part—a task spared the falcon who lays its eggs on the bare gound of a ledge on a cliff-side, or who uses an eyrie already built by another bird. Some time ago, I had a female Sparrow-hawk for seven years who regularly built a nest and “bred” in it without having laid a single egg. It was not my wish to deprive my Sparrow-hawk pair the pleasure of nest-building which should be a phase in natural procedure. This, however, was practically impossible, very likely on account of the flight disability of the female. She was not able to hold a long twig and then spring up to the nest, and when she wanted to carry a twig in her beak, it usually proved impossible. I arranged the artificial nest as a rather flat hollow on the nest foundations, bound the edges firmly and threw in a few bits of bark, gathered up from the forest, as I had seen in two Sparrow-hawk nests.

Egg-laying. In these days I often heard excited cries, from which I deduced that pairing had taken place. I was an eye-witness of such an act at midday on the 7th of April. On the 14th of April, a new egg lay in the nest and I noticed a large bare patch on the female. She brooded, however, only infrequently and for hours on end, sat on a branch or on the edge of the nest so there was no possibility that this egg would be hatched. On the 20th of April at 8:30 a.m., a second egg lay in the nest and from now on, the female brooded continually.

Brooding. Intervals from brooding in order to feed lasted from 8-10 minutes; in this connection I never noticed that the female was away from the nest. The now closely guarded feeding place was on the floor amongst the pine twigs in the furthest right-hand corner of the aviary (*i.e.* the furthest possible distance from the nest). It was here that the male consumed first the head of his prey, then, on the floor, less often on the lowest branch, gave the body to the female and then fetched the second mouse for himself. From this too, he took the head, either on the floor in the immediate vicinity of the female or then on the highest branch (up to now his feeding place). If the female consumed her portion, then the male gave her his remainder. Very often, she did not consume this completely but left it and then the male took the remainder again. On the 5th of May, I found the first egg which had been laid, in a crushed state; probably when turning it cracked against the second egg. Whilst the Sparrow-hawks were eating on the floor, unobserved, I removed it from the nest through the spy-glass. It was rotten and nothing could be deduced regarding the embryo.

Moulting. The two birds showed a different process. The female shed the first three flight feathers left and right before the 30th of April, the eighth left on the 28th of June, the ninth left on the 1st of

July. Tail moulting commenced between the 26th of April and the 3rd of May. As regards the large feathers, moulting came to an end at the beginning of July but owing to my absence, I could not check this. The male shed his first flight feathers before the 22nd of April, the two last on the 29th of August and the 4th of September respectively. Tail moulting commenced between the 6th and 8th of May and ended on the 4th of September. From these scanty dates, it would appear that in the female, the moult commenced with the start of actual breeding (second egg onwards) and the plumage changed during the period when she was closely confined to the nest. On the other hand, in the male, the moult commenced about the same time, proceeded slowly and was concluded about the time the young bird became self-supporting. In addition, this breeding in captivity had shown that the moulting process in the Sparrow-hawk stands in the closest connection with the division of duties between the species during propagation.

In order to avoid disturbance as much as possible, I only went into the aviary by night, at intervals of about a week and by the light of a very small torch, to collect the discarded flight and tail feathers. This explains the inexact dates.

The male during incubating activity. It was never possible to observe the male incubating. If he consumed his prey more quickly than the female, he flew to the edge of the unoccupied nest, observed the eggs, nodded and continually moved his beak towards the crop and breast (intention-movements to turn eggs?) trotted about on the spot and rocked on his heels (intention-movements to sit on the eggs?). Once he placed his rear toe under the front toe, exactly as the female folds her toes under when she sits on eggs or the young bird. When the female returned to the nest, the male disappeared immediately.

Hatching. On the 25th of May, the female remained on the nest for a remarkably long time in the morning until she left it to feed. I then discovered that on the longer side, the egg was damaged. On removing it from the nest, I immediately noticed a moving embryo through a tiny hole but could not hear anything. Quickly, I returned the egg to its place. At 17:30, an already dry, young bird lay in the nest, after an incubation period of 35½ days.

Care of the young bird. For the first food, after hatching, the male brought a mouse into the nest without hesitation, something which had never occurred before. The female took the mouse and in tiny morsels, tried to feed it to the young one. The first nine attempts, however, were unsuccessful on account of the still misdirected head movements of the young bird. Finally, he snatched

at three small pieces and, exhausted, fell asleep immediately. The female continued eating on the edge of the nest and offered all the little pieces of boneless meat which could be torn out of the food to the sleeping bird before she swallowed them herself. In the following days, as a rule, the male brought all the food to the nest, often directly to the youngster and only took the remainder for himself after the other two were satisfied. As soon as the female heard me putting food onto the feeding board, she stood erect and grumbled, remaining standing on the edge of the nest and no longer flying onto the lower middle branch as had been her habit before breeding time.

On the morning of his second day in the world, after three unsuccessful attempts, the youngster received 18 mouthfuls, at midday 19 and in the evening, 22. On the 6th day, the young bird already consumed a meal of 92 mouthfuls! At the beginning, the female sat on the nest continually but as the young bird grew, she gradually ceased.

Comparison can be made with the figures in the adult male of which, in three feedings during February 1968, I counted 180, 370, and 460 mouthfuls (swallowed) of an 18 gram heavy skinned mouse. With a good appetite, even under pressure of fear that the female could quarrel with him over the food, large morsels were swallowed: the same quantity of food represents about 70 mouthfuls.

Disturbance. From the 10th of June onwards, handing over the food gradually developed into a wild tussle. Even when a surplus was placed on the feeding board, the male would neither give up his prey on the floor nor on the nest and the female was not ready to serve herself independently from the feeding board. In the resultant pursuit, the mad chase led at times over the nest and I began to fear for the youngster. On the 13th of June, I removed him from the nest. Within a few days, the behavior of the adult male became normal as it was prior to breeding. I then brought up the young bird, a male, and looked after him until he convinced me that he could look after himself. After ringing him, on the 7th of August, I set him free.

Bibliography. Reports on birds of prey in captivity are found in the following works:

- Prestwich, A. A. (1955), Records of Birds of Prey bred in Captivity.
 Marquart, J. J. (1967), Reproduction des Rapaces diurnes Européens en Captivité (in: *Lien Ornithologique d'Alsace*, (Octobre).
 Koehler, A. (1968), Ueber die Fortpflanzung einiger Greifvogelarten in Gefangenschaft (in: *Der Falkner*).

In addition, the annual records of various organizations of falconers give accounts of breeding attempts and successful breeding,

especially of large falcons. Very valuable contributions to this subject are found in the reports of the "Raptor Research Foundation" (USA), which reached me only in the summer of 1969. Prestwich (1955) quotes a report on the Sparrow-hawk from the year 1899, where it was claimed that the species "have bred in captivity." Marquart doubts the correctness of this assertion and presumes that in this case, the Sparrow-hawk was confused with the Kestrel.